WHAT IS CLAIMED IS:

1. A two-speed transmission comprising:

a compound planetary train having a first planetary unit and a second planetary unit, the first planetary unit having an input shaft and the second planetary unit having an output shaft; and

a first electric machine and a second electric machine, wherein the first electric machine and the second machine are operatively connected to the compound planetary train to assist the two speed transmission from shifting between a first speed ratio R_1 and a second speed ratio R_2, wherein R_1 and R_2 are ratios between a rotating speed of the input shaft and a rotating speed of the output shaft.

2. The two speed transmission of Claim 1 further comprising a first locking device and second locking device.

3. The two speed transmission of Claim 2 wherein the first planetary unit includes a first sun gear that is operatively connected to the input shaft rotated by a motor, a first set of planetary gears, and a first ring gear.

4. The two speed transmission of Claim 3 wherein the first ring gear has a first bull gear that can be selectively connected to a first fixed member in the two speed transmission and that can be held stationary by activating the first locking device.

5. The two speed transmission of Claim 4 wherein the second planetary unit comprises a second set of planetary gears and a second ring gear, the second ring gear being integrated with a second bull gear that can be selectively connected to a second

fixed member in the two speed transmission and that can be held stationary by activating the second locking device.

6. The two speed transmission of Claim 5 wherein the first set of planetary gears in the first planetary unit is compounded with the second set of planetary gears in the second planetary unit to form a planetary cluster.

7. The two speed transmission of Claim 6 wherein the planetary cluster is supported on a common carrier which is operatively connected to an output shaft.

8. The two speed transmission of Claim 7 wherein, the first electric machine comprises a first rotor and a first stator, wherein the first rotor is connected to a shaft which in turn is connected to a first pinion gear, the first pinion gear meshing with the first bull gear.

9. The two speed transmission of Claim 8 wherein the second electric machine comprises a second rotor and second stator, wherein the second rotor is connected to a shaft which in turn is connected to a second pinion gear, the second pinion gear meshing with the second bull gear.

10. The two speed transmission of Claim 9 wherein the two electric machines and are electronically connected to each other either to supply or receive power to or from each other through a power control and converting unit.

11. The two speed transmission of Claim 9 wherein each electric machine and is connected through the power control and converting unit to external power sources.

12. The two speed transmission of Claim 11 wherein the two speed transmission operates primarily in two modes, the first mode resulting in the rotating

speed ratio R_1 between the input shaft and the output shaft, and the second mode resulting in the rotating speed ratio R_2 between the input shaft and the output shaft.

13. The two speed transmission of Claim 12 wherein in the first mode, the first ring gear is grounded by engaging the first locking device, fixing it to a first stationary member of the two speed transmission, wherein the second locking device is disengaged, leaving the second ring gear free-wheeling with the second bull gear, the input power received from the input shaft being transmitted to the first sun gear, then to the first set of planetary gears of the planetary cluster, then through the common carrier, and is then delivered to the output shaft, and wherein the input power is transmitted from the input shaft to the output shaft at the first speed ratio R_1.

14. The two speed transmission of Claim 13 wherein in the second mode, the second locking device is engaged, grounding the second ring gear together with the second bull gear to the second stationary member, wherein the first locking device is disengaged, freeing the first ring gear and the first bull gear, wherein the input power is received from the input shaft and goes through the first sun gear, and through both sets of planetary gears and of the planetary cluster, to the common carrier, and then is delivered to the output shaft, and wherein the input power is transmitted from the input shaft to the output shaft at the second speed ratio R_2.

15. The two speed transmission of Claim 14 wherein, in the first mode of operation, as the first ring gear is grounded to the first stationary member, it provides a reaction torque to balance the differential torque between the input shaft and the output shaft that are rotating at the first rotating speed ratio R_1.

16. The two speed transmission of Claim 15 wherein, in the second mode of operation, the second ring gear is grounded and provides a reaction torque to balance the differential torque between the input shaft and the output shaft that rotate at the second rotating speed ratio R_2.

17. The two speed transmission of Claim 16 wherein, while shifting from the first mode to the second mode, the first locking device is released, wherein upon such release a command is sent to the second electric machine to provide a reaction torque that tends to retard the rotation of the second ring gear along with the second bull gear such that the second electric machine generates electric power.

18. The two speed transmission of Claim 17 wherein the electric power generated during the shift from the first mode to the second mode is fed through the power control and converting unit to power the first electric machine to thereby share the reaction torque which otherwise is taken by the first electric machine, such that as the speed of the second electric machine decreases, the speed of the first electric machine increases and the share of reaction torque shifts toward the second electric machine until the second electric machine comes to a stop and reaction torque is solely taken by the second electric machine after which the second locking device is then engaged, fixing the second ring gear to ground and lifting the reaction torque off the second electric machine thereby completing a shift of the two speed transmission from the first mode to the second mode.

19. The two speed transmission of Claim 18 wherein shifting from the second mode into the first mode is executed when the above process is generally reversed.

20. The two speed transmission of Claim 19 wherein the maximum power rating of the first electric machine and the second electric machine is generally determined by a speed ratio span between the first rotating speed ratio R_1 and the second rotating speed ratio R_2.

21. The two speed transmission of Claim 20 wherein for rotorcraft, the desired speed ratio span between R_1 and R_2 is about 1.2 and the maximum power required for the first and second electric machines is about 5% of a maximum transmission power rating.

22. The two speed transmission of Claim 21 wherein during operation of the two speed transmission, one of either the first electric machine or the second electric machine is idling and can generate electric power.

23. The process of manufacturing a two speed transmission comprising the steps of:

manufacturing a two-speed transmission comprising:

a compound planetary train having a first planetary unit and a second planetary unit, the first planetary unit having an input shaft and the second planetary unit having an output shaft; and

a first electric machine and a second electric machine, wherein the first electric machine and the second machine are operatively connected to the compound planetary train to assist the two speed transmission from shifting between a first speed ratio R_1 and a second speed ratio R_2, wherein R_1 and R_2 are ratios between a rotating speed of the input shaft and a rotating speed of the output shaft;

assembling the two speed transmission such that the two speed transmission

operates primarily in two modes, the first mode resulting in a rotating speed ratio R_1 between the input shaft and the output shaft, and the second mode resulting in a rotating speed ratio R_2 between the input shaft and the output shaft.

24. The process of Claim 23 wherein in the first mode, a first ring gear is grounded by engaging a first locking device, fixing it to a first stationary member of the two speed transmission, a second locking device is disengaged, leaving the second ring gear free-wheeling with a second bull gear, wherein the input power received from the input shaft is transferred to a first sun gear, then to a first set of planetary gears of a planetary cluster, then through a common carrier, and is then delivered to the output shaft, and wherein input power is transmitted from the input shaft to the output shaft at the first speed ratio R_1.

25. The process of Claim 24 wherein in the second mode, a second locking device is engaged, grounding the second ring gear together with the second bull gear to the second stationary member, wherein the first locking device is disengaged, freeing the first ring gear and the first bull gear, wherein the input power is received from the input shaft and goes through the first sun gear, and through two sets of planetary gears and of the planetary cluster, to the common carrier, and then is delivered to the output shaft, and wherein the input power is transmitted from the input shaft to the output shaft at the second speed ratio R_2.

26. The process of Claim 25 wherein in the first mode, as the first ring gear is grounded to the first stationary member, it provides a reaction torque to balance a

differential torque between the input shaft and the output shaft that are rotating at the first rotating speed ratio R_1.

27. The process of Claim 26 wherein in the second mode of operation, a second ring gear is grounded and provides a reaction torque to balance the differential torque between the input shaft and the output shaft that rotate at the second rotating speed ratio R_2.

28. The process of claim 27 wherein, while shifting from the first mode to the second mode, the first locking device is released, wherein upon such release, a command is sent to the second electric machine to provide a reaction torque to retard the rotation of the second ring gear such that the second electric machine converts mechanical power into electrical power, and wherein the electric power generated during the shift from the first mode to the second mode is fed through the power control and converting unit to power the first electric machine to thereby share the reaction torque which otherwise is taken by the second electric machine, wherein the first electric machine drives the first bull gear along with the first ring gear and the first ring gear rotates in an opposite direction as the second ring gear such that as speed of the first electric machine increases, the speed of the second electric machine decreases and the share of reaction torque shifts toward the second electric machine until the second electric machine comes to a stop and reaction torque is solely taken by the second electric machine and the second locking device is then engaged, fixing the second ring gear to ground and lifting the reaction torque off the second electric machine thereby completing a shift of the two speed transmission from the first mode to the second mode.

29. The process of claim 28 wherein shifting from the second mode into the first mode is executed when the above process is generally reversed.

30. A two speed transmission comprising:

means for accepting a rotary input from a motor;

means for transmitting the rotary input from the means for accepting the rotary input to a means for generating a rotary output having a rotating speed ratio of one of either R_1 or R_2; and

means for changing the rotary output from a rotating speed ratio of R_1 to R_2, and from R_2 to R_1, the means for changing the rotary output having means to shift form R_1 to R_2 and from R_2 to R_1 in a generally smooth manner and substantially without abrupt changes in the rotary output.